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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/762,666	01/22/2004	Carlos Dangelo	NANOC002NP	5164

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EXAMINER	
PAREKH, NITIN	

ART UNIT	PAPER NUMBER
2811	

DATE MAILED: 04/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/762,666	DANGELO, CARLOS	
	Examiner	Art Unit	
	Nitin Parekh	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02-08-06*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21 and 28-32* is/are pending in the application.

4a) Of the above claim(s) *1-21* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *28-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 January 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dahl et al. (US Pat. Application Pub. 2002/0130407) in view of Cromwell (US Pat. 5926370).

Regarding claim 28, Dahl et al. disclose an integrated circuit (IC) chip substrate/die having enhanced power dissipation and improved heat transfer structure (see Fig. 6C), the IC chip/die comprising:

- a substrate (601 in Fig. 6C) having a top surface upon which power generating devices of the IC are fabricated (see sections 0116 and 0136; 601/901 in Fig. 6/9 respectively) and a back/bottom surface essentially parallel to the top surface
- a plurality of cavities/holes (see 633/634 in Fig. 6C) extending a predetermined distance from the bottom surface to the top surface, the

predetermined distance being less than the distance between the top and bottom surfaces, the cavities/holes being filled with heat conductive media (HCM) in a form of heat conducting conduits or heat pipe including highly thermally conductive medium comprising a variety of diamond containing material (sections 0007 and 0118-0122) and the cavities/holes being distributed/located directly below the IC devices/power generating devices of the substrate to provide the heat removal from the desired areas of the substrate (see Fig. 6C)

- the HCM having thermal conductivity greater than the substrate/silicon, and
- the heat produced by the IC devices/power generating devices being transferred to the back/bottom surface via the HCM

(Fig. 6C; sections 00116-0122).

Dahl et al. fail to teach the HCM comprising copper.

Cromwell teaches a heat dissipation/heat sink structure using conventional heat pipes (31 in Fig. 4b) where the heat pipes are made of conventional metal such as copper (Col. 10, line 22; Col. 9 and 10).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the HCM comprising copper as taught by Cromwell as an obvious alternative serving the purpose of heat management/dissipation in Dahl et al's IC cooling structure.

3. Claims 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dahl et al. (US Pat. Application Pub. 2002/0130407) in view of Montgomery et al. (US Pat. Application Pub. 2003/0117770).

Regarding claims 29 and 30, Dahl et al. disclose an integrated circuit (IC) chip substrate/die having enhanced power dissipation and improved heat transfer structure (see 601 in Fig. 6C), the IC chip/die comprising:

- a substrate having a top surface upon which power generating devices of the IC are fabricated (see sections 0116 and 0136; Fig. 6 and 9) and a back/bottom surface essentially parallel to the top surface
- a plurality of cavities/holes (see 633/634 in Fig. 6C) extending a predetermined distance from the bottom surface to the top surface, the predetermined distance being less than the distance between the top and bottom surfaces, the cavities/holes being filled with heat conductive media (HCM) in a form of heat conducting conduits or rods including thermally conductive medium comprising a variety of diamond containing material (sections 0007 and 0118-0122) and the cavities/holes being distributed/located directly below the IC devices/power generating devices of the substrate to provide the heat removal from the desired areas of the substrate (see Fig. 6C)

- the HCM having thermal conductivity greater than the substrate/silicon, and
- the heat produced by the IC devices/power generating devices being transferred to the back/bottom surface via the HCM

(Fig. 6C; sections 00116-0122).

Dahl et al. fail to teach the HCM comprising carbon nanotubes.

Montgomery et al. teach a thermal interface structure (TIS)/heat dissipation structure wherein the HCM comprises heat conducting rods in form of carbon nanotubes (see 26 in Fig. 4) to provide improved thermal conductivity and heat dissipation between a die and a heat sink for the TIS (sections 0013 and 0017; pp. 1 and 2).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the HCM comprising carbon nanotubes as taught by Montgomery et al. so that the thermal conduction and heat dissipation can be improved in Dahl et al's IC.

Regarding claims 31 and 32, Dahl et al. and Montgomery et al. teach the entire claimed structure as applied to claims 29 and 30 above, wherein Dahl et al. teach the IC devices/power generating devices comprising transistors having source/drain regions (see 902 in Fig. 9; section 0136), such device configuration in the IC package having the plurality of cavities/HCM being distributed/located along the bottom surface of the

substrate (see Fig. 6C) provides the cavities/HCM directly below respective source, drain and isolation regions.

Response to Arguments

4. Applicant's arguments Applicant's arguments filed on 02-08-06 have been fully considered but they are not persuasive.

A. Applicant contends that Cromwell teaches nothing about how to make an integrated circuit die with enhanced power dissipation.

However, the primary reference (Dahl et al.) discloses the IC die having enhanced power dissipation and improved heat transfer structure. Cromwell is applied to Dahl et al. to provide the heat dissipation/heat sink structure comprising the heat pipes made of conventional copper metal (Col. 10, line 22; Col. 9 and 10).

B. Applicant contends that Cromwell does not teach copper heat pipes in a cavity in an IC die.

However, the primary reference (Dahl et al.) discloses the IC die having plurality of cavities/holes (see 633/634 in Fig. 6C) extending a predetermined distance from the bottom surface to the top surface, the cavities/holes being filled with heat conducting conduits/heat pipes. Cromwell is combined with the primary reference to provide the heat pipes made of copper.

C. Applicant contends that there is no teaching in Dahl et al. of how to make copper conduits how to make copper conduits in fiber/rigid/flexible form or how to insert from about 1 to 100 copper conduits into the chip; or how to communicate with thermal vias.

However, as explained in the rejections above, Cromwell is combined with Dahl et al. to provide the missing elements in Dahl et al's power/heat dissipation structure. Furthermore, the claims under examination are directed to the device and not a method of making such device.

D. Applicant contends that Montgomery et al. do not teach the carbon nanotubes within the IC die or making such structures within the IC die.

However, the primary reference (Dahl et al.) discloses the IC die having plurality of cavities/holes (see 633/634 in Fig. 6C), the cavities/holes being filled with heat conducting conduits/rods. Montgomery et al. combined with the primary reference to provide the heat conducting rods in the form of carbon nanotubes (see 26 in Fig. 4).

Conclusion

5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nitin Parekh whose telephone number is 571-272-1663. The examiner can normally be reached on 09:00AM-05:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAN or Public PAG. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAG system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). Any inquiry of a general nature or relating to the

status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Nitin Parekh

NP

04-22-06

NITIN PAREKH

PRIMARY EXAMINER

TECHNOLOGY CENTER 2800